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Safety growth Biostimulant to improve Vegetative Growth,Tuber Productivity and Fixed Oil Content of Tiger Nut (Cyperus esculentus L.) Plant.

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Abstract

Tiger nut (*cyperus esculentus* L) is an underutilized crop belongs to family Cyperaceae , A field experiment was performed during two successive summer seasons of 2022 and2023 to explore the effect of applying sea weed (Ascophyllum nodosum)extract at (0,2,3.4 or 4g/L^{-1})as soil drench or foliar spray at (0,1,2 g/L^{-1}) and /or Chitosan soil drenched and sprayed both at (2cm/L^{-1}) Humic acid as foliar spray at (2g /L^{-1}) and soil drenched at (4g/L^{-1}) or Glutamic acid foliar spray at (1 and 2g/L^{-1})on tiger nut tubers , its fixed oil yields and constituents. Results showed that both methods of application sea weed extract positively influenced growth and tuber productivity ,soil drench of seaweed extract at 4g/L^{-1} followed by 3g/L^{-1} showed an increases in,fresh , dry weights / plant, tuber, fixed oil yields / plant and feddan whereas the foliar application of sea weed by both rates 2g/L^{-1} followed by 1g/L^{-1} caused more promising effect than drenching application. The combined of both methods of application 4g/L^{-1} and2g/L^{-1} followed by 3g/L^{-1} and 2g/L^{-1} significantly ameliorated these impacts as they induced the highest values of vegetative growth traits, tuber and fixed oil yields / plant or feddan . The highest values of the main oil component of unsaturated fatty acids, flavonoids ,flavonoid glucoside , terpenoids and aromatic acids. Apply sea weed (Ascophyllum nodosum) extract as soil drench at 4g/L^{-1} and or 3g/L^{-1} with foliar sprayed sea weed 2g/L^{-1} is recommended to improve tiger nut tubers, and their fixed oil productivity.

Key words: *cyperus esculantus*, some biostimulants, vegetative growth, tuber and chemical constituents

Introduction

Tiger nut "Cyperus esculentus Lativum" which to Cyperaceae and it is known by other names like chufa, yellow nut sedge, earth almond and ground almond. It is a perennial crop cultivated extensively in Asia, East Africa, parts of Europe particularly Spain as well as in the Arabian Peninsula (Abdelkader et al., 2017). Tiger nut is erect, with yellowish-green leaves, triangular stem about 20 to 60 cm tall, superficial rhizomes that store proteins, starches and other nutrients. This plant produced many tubers and golden-brown flower head. The plant forms a complex, shallow underground system composed of fine fibrous roots, thin scaly rhizomes, and spherical tubers appear somewhat long or round with a dimension of 8 mm to 16 mm (Abdelkader et al., 2017). Tiger nuts are appeared to have more prospective usage as nourishment and industrial materials; it can be used to produce beverage, milk or yogurt, flour, nougat, jam, beer, chocolate, a feed source, edible oil and as soaps (Achoribo and Ong, 2017).

One type of bio-stimulant that is produced from seaweed, particularly brown algae(Ascophllum nodosum), is called seaweed extract (Chapman and Chapman, 1980). Seaweed extract (SE) is rich in macro and micronutrients and mainly contains natural hormones, such as gibberellin, cytokinin, auxin, abscisic acid, and other active substances such as seaweed betaine, polysaccharide, sugar alcohol, and phenolic compounds (Battacharyya et al., 2015). Also, it increased plant root and shoot growth Due to its high cytoknins content (Alam et al., 2013), enhanced plant absorption of nutrients from the soil (Boukhari et al., 2020). Biostimulants foliar application is being utilized more and more in modern agriculture to replace traditional foliar fertilizers .Foliar biostimulants are utilized as an innovative and eco-friendly strategy to increase crop yields, nutrient-use efficiency, resistance to various abiotic stressors, and plant growth (Rakkammal et al., 2023). They contain physiologically active substances and allow a reduction in the amount of agricultural inputs used compared with traditional foliar fertilizers (Consentino et al., 2023).

Chitosan is a natural polymer, composed of β-1,4-linked N-acetyl-d-glucosamine (N-GlcNAc) and d-glucosamine subunits. It is used in a range of applications to benefit humanity. In biomedical and pharmaceutical applications, it is used as a drug carrier, vaccine adjuvant, wound dressing material, and cartilage and bone tissue engineering scaffold (Muxika et al. 2017). Chitosan is also utilized in the food and agricultural industries owing to its antimicrobial, antifungal, and plant defense-eliciting properties (Pongprayoon et al. 2022). The metabolite profile of chitosan is known to boost plant development processes and induce defense responses in plants. The use of these biostimulants in the cultivation of medicinal plants aims to enhance the secondary metabolite synthesis and increase the biomass output (Rafiee et al., 2016) .Chitosan enhances crop production through its bioactivities of biodegradability, growth stimulation, enhancement of nutrient uptake, improvement in chlorophyll content, chloroplast enlargement, and antibacterial characteristics (Hadrami et al., 2010) .

Popular plant biostimulant is humic acid (HA) is a natural stimulator substance that is a rich source of macronutrients, such as nitrogen, phosphorus, and sulfur, which can enhance root initiation, stimulate plant growth, and improve soil fertility, especially in sandy soil [Yuan et al., b2022]. As a biostimulant, HA also affects plant growth and development directly via nutritional, hormonal, or elicitory pathways (Conselvan et al., 2017). These findings have led many to believe that HA supplementation can enhance the biosynthesis of therapeutic secondary metabolites in medicinal plants.

Glutamic acid is an α- amino acid used in the biosynthesis of proteins and supports plant growth. It had a positive effect under stressful conditions, decreased physiological damage by promoting the development of chlorophyll molecule, carbohydrate anabolism, plant hormones and the activity of antioxidant enzymes. Glutamic acid supports plant growth (El- Metwally et al., 2022). Glutamic acid considers as the precursor of γ-aminobutyric acid (GABA) and proline under stress conditions (Shang et al., 2011).

Materials and methods

The current investigation was carried out at the research station **F**arm of Floriculture ,Horticulture Department Faculty of Agriculture,Benha University, Qalyubia Governorate, Egypt, during two consecutive summer seasons of 2022 & 2023 during the period from April to June for both seasons.The objective of the present experiment is to verify the hypothesis of seaweed extracts with some biostimulants (humic acid,chitosan and glutamic acid) might enhance morphological characters, tuber production, fixed oil yield and content of tiger nut (Cyperus esculantus L.) plant .

Experimental preparation

An open field was the location of the present research at the Experimental Farm of Floriculture Horticulture Department Fac.of Agric at Moshtohor,Tokh,Qalyubia(Longitude:31.22,Latitude :30.35 and Altitude:15),Egypt. Before planting a part of top soil were removed and Firstly the soil was mechanically ploughed deeply (35-45cm) twice, weed plants were tilled completely with their roots and removed ,during tilling the soil were planked twice till the soil surface had been settled. The experimental location was prepared and divided into ridges with 70 cm abart between them, The middle top of the ridge were filled by washed sand (about 4.5 m^3 sand for the whole experimental area (200m^2). The seeding rate is 150kg/feddan . The area was divided into expiremntal plot(length 1m× width1m) contain 25 plants.

Soil traits were measured according to Jackson(1973)and Black et al.(1982). and the initial physico-chemical parameters were Tabled.

Mechanical and chemical analysis of the experimental soil.

Mechanical properties			Chemical analysis		
Parameters	Values 2022-2023	Values 2023-2024	Parameters	Values 2022-2023	Values 2023-2024
Sand	68.55 %	65.23 %	**Organic matter**	1.55	1.77
Silt	24.55 %	25.77 %	**$CaCO_3$**	1.02	1.08
Clay	25.42 %	26.5 %	**Available nitrogen (mg kg^{-1})**	0.69	0.74
Textural class	Sandy loam	Sandy loam	**Available phosphorus (mg kg^{-1})**	0.38	0.42
			Available potassium (mg kg^{-1})	133	144
			PH	7.13	7.32
			EC (dS/m)	0.84	0.93

The seeds of tiger nut(Cyperus esculants)were obtained from a private farm at Rashied El-Behiera Governorate.Uniform and healthy tubers (seeds) with an average weight 34.4(g) for 100 seeds. On April 10th in 2022 and 2023 the seeds were sown in hills /5cm apart by adding about 4-5 seeds in each hill in the middle of each ridge .After twelve days the germination were begun, then each hill was trimmed to remove feeble seedlings for keeping the strongest seedlings per hill 3 plant/hill**.** Chemical fertilizers:

two days before planting chemical fertilization of calcium superphosphate(15%P_2O_5) at the rate of 100kg/feddan was cooperated into the soil.

Nitrogen fertilization as ammonium sulfate (20.5%) at 200kg/feddan was split to four equal doses, the first was added one day before planting and the three other doses were performed at two weeks interval .

Potassium fertilization as potassium Nitrate(33%) at the rate of 50kg/feddan was split to four doses ,the first was added one month after planting, the second and third doses were added after fifteen days intervals .

Treatments

After seventeen days from planting in both seasons when seedlings were reached an average length between 16-18cm,amending soil treatments was installed to the soil as follows:sea weed extract (Ascophyllum Nodosum+(potassium k 10%)) manufacturerAtlas company ,Egypt.

Added by dissolving 2.0,3.0, and 4.0g/L^{-1} per plot(1m) as soil drenching application in addition to control treatment 0.0g/L^{-1}. for each amending soil drench treatments by sea weed extract the following treatments were performed trible doses throughout the experimental peroid at fifteen days intervals**.**

1-Sea weed extract was foliar sprayed at concentrations of 0.0,1.0 and 2.0g/L^{-1}/plot .

2-Humic acid HA- (potassium humat) product of Alnowr agricultural fertilizers company at the rate of 0.0 and 2.0g/L^{-1} both as foliar spraying and /or at 0.0 and 4g/L^{-1} both as soil drenching application.

3-Chitosan at the rate of 0.0 and 2.0cm/L^{-1} both as foliar spray and /or both as soil drenching application .

4-Glutamic acid at the rate of 0.0,1.0 and 2.0g/L^{-1} both as foliar spraying application .

Other agricultural practices,irrigation and weeding were carried out when nedded .Plants aged 90 days were collected when leaves color turned yellow and cessation of new inflorescence occurred and then tubers were gently removed with their leaves.

Twenty plants from each plot were chosen randomly and were left on shelves four weeks in a shaded drying yard for complete dryness.The experimental configuration had built on a randomized complete block design (R C B D) with three replicates .

The experiment consist of four soil drenching application of sea weed extract and 4 types of biostimulants, applied by two application methods foliar spray and soil drench .

Data recorded:

Vegetative growth parameters:

1- Herb fresh weight(g)

2- Herb dry weight(g)

Tubers parameters and yield :

1- Tuber's fresh weight /plot (g)

2- Tuber's dry weight /plot (g)

3- Tuber's fresh weight /fed (kg)

4-Tuber 's dry weight /fed (kg)

Fixed oil measurements:

1- fixed oil yield /100g of tubers (mm)

3- GCmass

2- fixed oil yield /fed of tubers (L^{-1})

Extraction of fixed oil:

The AOAC (1984) techniques were followed in order to extract a fixed oil percentage from tiger nut tuber using hexane in a Soxcelt system HT apparatus.

Gas chromatography-mass spectrometry (GC/MS) analysis:

A GC (Agilent Technologies 7890A) with a mass-selective detector running on an HP-5ms capillary column (30 µm x 0.25 mmi.d. and 0.25 µm film thickness) was used at the Regional Center for Food and Feed (RCFF), ARC, Giza, Egypt to determine the methanolic extract. At a pace of 3 degrees Celsius per minute, the temperature was raised from 80 to 230 degrees. Helium was the carrier gas, flowing at a rate of 1 milliliter per minute. The process of bioactive chemical identification involved computer matching with the National Institute Standard and Technique database, as well as comparing the mass spectra and retention times of the compounds with those of genuine standards.

Statistical analysis:

Analysis of variance (ANOVA) was used to examine the values of all the data that were gathered as part of simple investigations carried out in a complete randomized block design. LSD at5% and 1% test were used to differentiate means according to Snedecor and Cochran (1980).

Results and Discussion

Estimations of vegetative parameters:

Growth parameters of tiger plants in response to different application of soil dressing sea weed doses and exogenous foliar spraying or soil dressing of some biostimulants ,sea weed, chitosan ,humic acid and glutamic acid.

Vegetative growth parameters:

1- **Herb fresh and dry weights g/ plant**

Data illustrated in Table(1) showed that fresh weight of tiger plant was improved with all studied factors during the two seasons. However sea weed 4g/L^{-1} applied as soil drench significantly increased fresh weight as compared to control (0.00sea weed),the values recorded(41.30,42.90g/plant)and(29.26,29.99g/plant) in the first and second seasons ,respectively .Moreover ,sprayed sea weed 2g/L^{-1} followed by 1g/L^{-1} as well as sprayed glutamic 1g/L^{-1} were scored significant values compared with control and other biostimulants in most cases. The highest superior interaction values were recorded by tiger plants treated with soil drenched sea weed 4g/L^{-1} and 3g/L^{-1} with sprayed sea weed 2g/L^{-1} tratments followed by the combined treatment of soil drenched sea weed 4g/L^{-1} with sprayed glutamic acid 1g/L^{-1} in both studied seasons.

Asimilar trend to those found on herb fresh weight was also obtained on herb dry weight of tiger plant (Table2). Adding soil drenching sea weed at higher dose 4g/L^{-1} was more effective than lower doses(0.0, 2g & 3g/L^{-1}).the heaviest herb dry weight were recorded by tiger plants sprayed with 2g/L^{-1} sea weed followed by 1g/L^{-1} sea weed in both seasons .Values of interaction of studeid factors showed that the highest herb dry weights of tiger nut plants were recorded in both seasons in plants recived soil drench sea weed 4g/L^{-1} followed by3g/L^{-1} with spraying sea weed 2g/L^{-1} .

Ghayoumi-mohammadi and Asadi-gharneh (2019) on *Hibiscus sabdariffa* , indicated that the use of seaweed at 1.5 g/L^{-1} increased, fresh , dry weights of plant and it's calyx yield.

Tuber parameters:

1-Fresh and dry weights of tubers /plot

Tables (3&4) revealed that all tested treatments of the growth stimulants succeeded in increasing the fresh and dry weights of tubers of cyperus esculantus plants as compared to control (untreated plants) in both seasons. It is obvious from the obtained data that raising the rate of sea weed applied as soil drench from 2.0 to 3.0 and 4g/L^{-1} gradually increased the fresh and dry weights of tubers of tiger plants. Also,raising the sprayed rat of sea weed from 1g/L^{-1} to 2g/L^{-1} significantly increased the fresh and dry weights of tubers recording the heaviest weights in both seasons.Regarding the combined treatments of seaweed applied as soil drench and other biostimulants ,the data cleared that application 4g/L^{-1},3g/L^{-1} and 2g/L^{-1} of soil drenched sea weed +spraying with sea weed .2g and or 1g/L $^{-1}$were the most effective in increasing the fresh and dry weights of tubers in the first and second seasons,respectively.Moreover the heaviest fresh and dry weights of tubers were gained from 4g/L soil drenched sea weed +2g/L^{-1} sprayed sea weed (495.4 & 492.7 g/plot) and (126.3 & 124.7 g/dry weight per plot) as compared with control (untreated plants)which gained (103.3 & 97.67 g/fresh weight per plot)and (36.67 & 40.00g/dry weight per plot) in the first and second seasons, respectively.

2-fresh and dry weights of tubers /fed (kg)

Data illustrated in Tables (5&6) showed that the highest values of fresh and dry weights yield of tubers were recorded in tiger nut plants treated by soil drenched sea weed 4g/L^{-1} in both seasons. Whereas the treatment of sprayed sea weed 2g/L^{-1} came first ,it was superior than others biostimulants,followed by sprayed sea weed 1g/L^{-1} and sprayed chitosan 2cm/L^{-1},whome had no significant differences between them and occupied the third position in increasing the fresh and dry weights yields of tiger nuts tubers. The combination treatments were scored significant in all cases ,where the highest interaction values were recorded by tiger nut plants treated with 4g/L^{-1} soil drenched sea weed +2g/L^{-1} sprayed sea weed as yielded (2080.68 and 2069.34 kg fresh weight tubers /fed)and (530.46 and 523.74 kg dry weight tubers/fed) as compared with control 0.00 yielded (433.68 and 410.21 kg dry weight tuber/fed) and (162.41 and 168.00kg dry weight tubers/fed) in the first and second seasons,respectively.an addition the combind treatment of sea weed 4g/L^{-1} applied as soil drench and sea weed 2g/L^{-1} applied as foliar sprayed resulted in the highest yielded tubers kg/fed as recorded .(2066.40 and 2068.50 kg fresh weight tubers/fed) and (514.92 and 525.00 kg dry weight tubers /fed)in the first and second season,respectively and occupied the second position .this was followed by 2g/L^{-1} soil drenched sea weed +2g/L^{-1} sprayed sea weed as recorded (2060.10 and 2052.54kg fresh weight tubers /fed) and (508.20 and 501.06kg dry weight tubers /fed) in the first and second seasons ,respectively. These findings are propped up to

El-Gamal and Ahmed (2016) on dill (*Anethum graveloens* linn.) plants, showed that the foliar application of MLE (Moringa leaf extract) and SW(seaweed) at 0.5 m1/1 improved vegetative growth plant height, number of branches per plant and plant fresh and dry weights and seed yield characters than the control with the superiority of SW during the two growing seasons.

1-**Fixed oil content %of 100g of tiger nut tuber**

Table (7) shows the effects of soil drenched application of 3doses of sea weed (Ascophyllum nodosum) and other sprayed or soil drenched biostimulants,chitosan ,humic acid and sprayed sea weed and glutamic acid on fixed oil content of 100g of tiger nut tubers. Treating plants with the higher dose of sea weed soil drench (4g/L^{-1}) was significantly ($p \leq 0.01$) increased by 31.50% and 23.24% over control (untreated plants) in the first and second seasons ,respectively .Respective of the biostimulant treatments ,sprayed sea weed 2g/L $^{-1}$ had the highest values of fixed oil yield as compared to other biostimulants and control in both seasons, in addition sprayed sea weed 1g/L^{-1} occupied the second position in increasing the fixed oil content ,followed by soil drenched humic acid 4g/L^{-1} in both seasons . concerning interaction,drenching sea weed 4g/L^{-1} +sprayed sea weed 2g/L $^{-1}$ significantly ($p \leq 0.01$)increased oil yield followed by both treatments of (soil drenched sea weed 4g/L^{-1} +sprayed sea weed 1g/L^{-1}) and (soil drenched sea weed 3g+ sprayed sea weed 2g/L^{-1}), as they were gained approximately the same values .in addition drenching treatments of sea weed 4g+ humic acid 4g/L^{-1} occupied the third position in increasing the fixed oil content of tubers of cyperus esculantus.

2-Fixed oil content of tubers L/fed

Data in table (8) showed that all sea weeds and biostimulants treatments had a significant effect compared to control (untreated plants)in fixed oil content of tiger nut tubers L^{-1}/fed . in most cases in both seasons.reducing the sea weed soil drenched doses from 4g/L^{-1} to 2g/L^{-1} decreased significantly the fixed oil content and yield /fed as compared with the higher doses of 3g/L^{-1} and 4g/L^{-1} sea weed soil drenched in both seasons. Whereas sprayed sea weed at 2g/L^{-1} increased significantly fixed oil yield of tubers L^{-1}/fed (153.63 and 164.13 L/fed)followed by sprayed sea weed to 1g/L^{-1} as recorded (129.6 and 138.33L^{-1}/fed),also glutamic acid ranked the third as gained (112.01 and 116.97 L^{-1}/fed),while the lowest values (40.37 and 48.68 L^{-1}/fed)was gained with control (0.00 biostimulants) in the first and second seasons ,respectively.regarding the effect of interaction it could be noticed that soil drenched sea weed 4g/L^{-1} + sprayed sea weed 2g/L^{-1} resulted in the highest values of fixed oil content (187.14 and 188.23 L^{-1}/fed followed by soil drenched sea weed at 3g/L^{-1} +sprayed sea weed 2g/L^{-1} (172.85 and 183.33 L^{-1}/fed) also ,soil drenched sea weed 4g/L^{-1} + sprayed sea weed 1g/L^{-1} (155.4 and 159.61 g/L^{-1}) occupied the third position with soil drenched sea weed 2g/L^{-1} + sprayed sea weed 2g/L^{-1}(149.25 and 155.42L/fed)in the first and second seasons, respectively .the control (untreated plants) gave the least yield of fixed oil /tubers L^{-1}/fed.(34.56 and 38.08) in the first and second seasons .

El-Gamal and Ahmed (2016) on dill (*Anethum graveloens* linn.) plants, showed that the foliar application of MLE (Moringa leaf extract) and SW(seaweed) improved essential oil characters more than the control with the superiority of seaweed

Table 1. Effect of seaweed extracts , some biostimulants and their interactions on fresh weight of herb(g) per plant of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
biostimulant(b)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	24.43	27.50	25.00	29.50	27.40	27.50	28.20	28.50	26.26	28.25
Chitosan(soil drench)2cm/L^{-1}	22.09	21.94	30.17	29.17	35.60	39.40	42.60	44.80	32.62	33.83
Chitosan(Spray)2cm/L^{-1}	21.59	23.54	28.83	38.82	43.54	47.04	47.04	45.50	35.25	38.73
Humic acid(spray)2g/L^{-1}	25.60	24.56	27.17	26.73	27.59	29.67	29.17	29.83	27.38	27.7
Humic acid(soil drench)4g/L^{-1}	27.59	27.97	29.7	29.44	36.21	37.70	39.33	41.07	33.21	34.05
Sea weed (Spray)1g/L^{-1}	35.96	38.60	43.04	44.77	47.59	45.06	46.83	46.10	43.36	43.63
Sea weed (Spray)2g/L^{-}	43.49	46.38	47.04	49.27	48.89	54.85	55.17	55.40	48.65	51.48
Glutamic acid(Spray)1g/L^{-1}	37.37	35.42	39.37	38.38	45.33	47.23	48.17	49.23	42.56	42.57
Glutamic acid(Spray)2g/L^{-1}	25.23	23.97	27.04	29.23	29.34	34.07	35.17	38.37	29.2	31.41
Mean	29.26	29.99	33.04	35.03	37.94	40.28	41.30	42.09		
Lsd at 0.05	First season: a= 2.18 Secondseason: a= 2.73				b= 3.3 b= 4.1				a*b=6.6 a*b= 8.2	
Lsd at 0.01	First season: a= 2.94 Secondseason: a= 3.69			b= 4.46 b= 5.54				a*b=8.91 a*b= 10.8		

Table 2. Effect of seaweed extracts , some biostimulants and their interactions on dry weight of herb (g)per plant of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	**Sea weed (0g)**		**Sea weed (2g)**		**Sea weed (3g)**		**Sea weed (4g)**		**Mean**	
biostimulant(b)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	12.83	13.67	14.80	14.50	15.00	15. 70	16.83	17.60	14.87	15.15
Chitosan(soil drench)2cm/L^{-1}	12.40	12.83	14.71	15.17	17.06	18.17	19.00	19.67	15.79	16.50
Chitosan(Spray)2cm/L^{-1}	12.50	13.00	13.38	15.94	19.09	21.23	24.50	27.17	17.37	19.38
Humic acid(spray)2g/L^{-1}	11.90	12.07	17.83	18.17	21.24	25.50	26.40	27.90	19.34	21.14
Humic acid(soil drench)4g/L^{-1}	13.90	13.17	14.50	15.27	16.27	16.07	17.17	18.23	15.46	15.41
Sea weed (Spray)1g/L^{-1}	20.17	24.83	25.27	26.97	28.07	31.50	30.10	35.83	25.9	26.99
Sea weed (Spray)2g/L^{-1}	25.99	28.53	31.17	32.10	35.21	37.67	38.17	38.83	32.64	31.78
Glutamic acid(Spray)1g/L^{-1}	13.41	13.00	14.83	15.07	17.00	19.91	19.07	21.30	16.08	21.2
Glutamic acid(Spray)2g/L^{-1}	13.71	13.67	15.70	14.24	17.07	19.17	21.17	22.50	16.91	17.4
Mean	15.20	16.09	18.02	18.6	20.67	21.02	23.60	25.44		
Lsd at 0.05	**First season: a= 2.36 Secondseason: a= 1.89**				**b= 3.6 b= 2.9**		**a*b= 7.2 a*b= 5.8**			
Lsd at 0.01	**First season: a= 3.19 Secondseason: a= 2.55**				**b= 4.86 b= 3.92**		**a*b= 9.7 a*b= 7.83**			

Table 3. Effect of seaweed extracts , some biostimulants and their interactions on fresh weight of tubers(g per m2) of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
biostimulant (b)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	103.3	97.67	99.2	104.5	106.3	103.0	105.0	106.0	103.45	102.79
Chitosan(soil drench)2cm/L-1	283.7	284.4	290.5	295.0	301.7	295.4	299.6	303.8	293.88	294.65
Chitosan(Spray)2cm/L-1	388.2	384.3	392.1	390.7	394 .0	390.5	397.0	397.4	392.82	390.73
Humic acid(sprar)2g/L-1	185.1	182.0	191.3	188.0	196.0	196.5	199.0	197.5	192.85	191
Humic acid(soil drench)4g/L-1	231.7	233.0	241.0	239.4	243.3	243.0	245.7	244.0	240.43	239.85
Sea weed (Spray)1g/L-1	388.7	388.0	392.3	394.0	397.3	399.7	401.0	399.2	394.83	395.23
Algae Sea weed (Spray)2g/L-1	480	483.5	490.5	488.7	492.0	492.5	495.4	492.7	489.48	489.35
Glutamic acid(Spray)1g/L-1	300.0	303.4	305.3	304.6	310.0	312.0	307.0	314.7	305.58	308.68
Glutamic acid(Spray)2g/L-1	283.0	285.3	295.6	298.3	310.0	306.0	321.0	318.2	302.40	301.95
Mean	293.7	293.51	299.7	3003.3	305.62	304.29	307.86	308.17		
Lsd at 0.05	First season: a= 4.21 Secondseason: a=5.08			b= 6.4 b= 7.7				a*b=12.8 a*b=15.4		
Lsd at 0.01	First season: a= 5.68 Secondseason: a=6.86			b= 8.64 b= 10.4					a*b=17.3 a*b=20.8	

Table 4. Effect of seaweed extracts ,some biostimulants and their interactions on dry weight of tubers(g) per plant of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	**Sea weed (0g)**		**Sea weed (2g)**		**Sea weed (3g)**		**Sea weed (4g)**		**Mean**	
biostimulantb)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	38.67	40.00	38.00	38.20 0	39.4	42.00	40.50	43.00	39.1 4	40.8
Chitosan(soil drench)2cm/L-1	69.67	66.33	70.67	73.70	75.60	77.00	80.20	80.50	74.04	74.38
Chitosan(Spray)2cm/L-1	64.33	66.00	68.00	68.33	69.50	71. 70	75.00	77.20	69.21	70.80
Humic acid(spray)2g/L-1	69.00	71.00	78.67	81.00	82.50	80.00	85.20	86.80	78.84	79.70
Humic acid(soil drench)4g/L-1	69.00	66.33	75.00	70.00	72.30	76.60	79.00	80.10	73.83	73.26
Sea weed (Spray)1g/L-1	97.00	97.67	103.7 0	105.7 0	107.7 0	104.3 0	109.0 0	109.3	104.3 5	104.2 4
Sea weed (Spray)2g/L-1	111.3 3	112.5 0	121.0 0	119.3 0	122.6 0	125.0 0	126.3 0	124.7 0	120.3 1	120.3 8
Glutamic acid(Spray)1g/L-1	90.33	94.30	98.00	98.67	104.7 0	102.2 0	106.0 0	104.3 0	99.76	99.87
Glutamic acid (Spray)2g/L-1	88.00	83.67	94.67	93.00	98.20	99.60	103.3 0	105.7 0	96.04	95.49
Mean	77.48	77.5 3	83.08	83.1 0	85.83	86.48	89.39	90.18		
Lsd at 0.05	**First season: a= 4.29 b= 6.5 a*b=13.0 Secondseason: a= 3.17 b= 4.8 a*b=9.6**									
Lsd at 0.01	**First season: a= 5.75 b= 8.76 a*b=17.6 Secondseason: a= 4.28 b= 6.48 a*b=12.9**									

Table 5. Effect of seaweed extracts , some biostimulants and their interactions on fresh weight of tubers of tiger nut /fed.(kg) plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
biostimulant (b)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	433.86	410.214	416.64	438.90	446.46	432.60	441.00	445.20	434.49	431.7285
Chitosan(soil drench)2cm^3/L^{-1}	1191.54	1194.48	1220.1	1239	1267.14	1240.68	1258.32	1275.96	1234.275	1237.53
Chitosan(Spray) 2cm^3/L^{-1}	1630.44	1614.06	1646.82	1640.94	1654.8	1640.1	1667.4	1669.08	1649.865	1641.045
Humic acid(sprar)2g/L^{-1}	777.42	764.40	803.46	789.60	823.20	825.30	835.80	829.50	809.97	802.2
Humic acid(soil drench)4g/L^{-1}	973.14	978.6	1012.2	1005.48	1021.86	1020.6	1031.94	1024.8	1009.785	1007.37
Sea weed (Spray)1g/L^{-1}	1632.54	1629.6	1647.66	1654.8	1668.66	1678.74	1684.2	1676.64	1658.265	1659.945
Sea weed (Spray)2g/L^{-1}	2016	2030.7	2060.1	2052.54	2066.4	2068.5	2080.68	2069.34	2055.795	2055.27
Glutamic acid(Spray)1g/L^{-1}	1260	1274.28	1282.26	1279.32	1302	1310.4	1289.4	1321.74	1283.415	1296.435
Glutamic acid(Spray)2g/L^{-1}	1188.6	1198.26	1241.52	1252.86	1302	1285.2	1348.2	1336.44	1270.08	1268.19
Mean	1233.726	1232.732	1258.973	1261.493	1283.613	1278.013	1292.993	1294.3		
Lsd at 0.05	First season: a=36.2 b= 54.3 a*b= 108.6 Secondseason: a=41.8 b= 62.7 a*b= 125.4									
Lsd at 0.01	First season: a= 26.8 b= 40.2 a*b= 80.4 Secondseason: a=30.9 b= 46.4 a*b= 92.8									

Table 6. Effect of seaweed extracts , some biostimulants on dry weight of tubers /fed(kg) of tiger nut plant during 2022/2023 and2023/2024 seasons.

Seaweed(a) (Soil drench) / biostimulantb)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	162.414	168.00	159.60	160.44	165.48	176.40	170.10	180.60	164.39	171.36
Chitosan(soil drench)2cm^3/L^{-1}	292.614	278.586	296.814	309.54	317.52	323.4	336.84	338.1	310.94	312.4
Chitosan(Spray)2cm^3/L^{-1}	270.186	277.20	2085.60	286.98	291.90	301.14	315.00	324.24	290.67	297.39
Humic acid(spray)2g/L^{-1}	289.80	298.20	330.414	340.20	346.50	336.00	357.84	364.56	331.10	334.74
Humic acid(soil drench)4g/L^{-1}	289.80	278.586	315.00	294.00	303.66	321.72	331.80	336.42	310.06	307.68
Sea weed (Spray)1g/L^{-1}	407.40	410.214	435.54	443.94	452.34	438.06	457.80	459.06	438.27	437.81
Sea weed (Spray)2g/L^{-1}	467.586	472.5	508.2	501.06	514.92	525.00	530.46	523.74	505.20	505.57
Glutamic acid(Spray)1g/L^{-1}	379.386	396.06	411.6	414.41	439.74	429.24	445.20	438.06	418.98	419.44
Glutamic acid (Spray)2g/L^{-1}	369.60	351.41	397.61	390.60	412.44	418.32	433.86	443.94	403.37	401.06
Mean	325.40	325.60	348.90	348.98	360.47	363.25	375.43	378.74		
Lsd at 0.05	First season: a= 27.4 b= 41.1 a*b=82.2									
	Secondseason: a=31.1 b= 46.7 a*b= 93.3									
Lsd at 0.01	First season: a= 20.3 b= 30.4 a*b=60.8									
	Secondseason: a= 23.1 b= 34.6 a*b= 69.1									

Table 7. Effect of seaweed extracts , some biostimulants and their interactions on fixed oil of tubers / 100g of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench) biostimulant(b)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	21.28	22.67	23.66	24.85	25.63	26.26	27.49	27.91	24.52	25.42
Chitosan(soil drench)2cm/L-1	22.60	23.62	24.62	26. 09	25.15	26.62	27.59	28.55	24. 99	26.22
Chitosan(Spray)2cm/L-1	21.88	23.88	24.75	25.09	26.21	27.02	29.39	29.21	25.56	26.30
Humic acid(spray)2g/L-1	22.85	24.72	24.85	26.20	27.80	28.5	28.00	28.72	25. 88	27.03
Humic acid(soil drench)4g/L-1	24.73	25.93	27.31	26.04	28.06	28.12	31.47	29.92	27.89	27.50
Sea weed (Spray)1g/L-1	23.34	28.54	28.80	30.12	31.56	32.63	33.89	34.77	29.40	31.52
Sea weed (Spray)2g/L-1	22.52	27.42	29.37	31.02	33.57	34.92	35.28	35.94	30.19	32.33
Glutamic acid(Spray)1g/L-1	23.25	24.96	26.13	26.77	27.14	28.07	29.84	31.42	26.59	27.80
Glutamic acid(Spray)2g/L-1	24.61	22.41	25.61	27.86	28.18	28.67	29.41	29.90	26.95	27.21
Mean	23.01	24.91	26.12	24.2	28.14	28.98	30.26	30.7		
Lsd at 0.05	First season: a= 0.71 b= 1.07 a*b=2.13 Secondseason: a = 0.83 b= 1.25 a*b=2.50									
Lsd at 0.01	First season: a= 0.96 b= 1.44 a*b=2.88 Secondseason: a = 1.12 b= 1.68 a*b=3.38									

Table 8. Effect of seaweed extracts, some biostimulants and their interactions on fixed oil of tubers / fed(L^{-1}) of tiger nut plant during 2022/2023 and2023/2024 seasons.

Sea weed(a) (Soil drench)	Sea weed (0g)		Sea weed (2g)		Sea weed (3g)		Sea weed (4g)		Mean	
biostimulant(b)	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Control	34.56	38.08	37.76	39.86	42.41	46.32	46.76	50.40	40.37	43.66
Chitosan(soil drench)2cm/L^{-1}	66.13	65.80	73.07	80.75	79.85	86.08	92.93	96.52	77.99	82.28
Chitosan(Spray) 2cm/L^{-1}	59.11	66.19	70.68	72.00	76.50	81.36	92.57	94.71	74.71	78.56
Humic acid(spray)2g/L^{-1}	66.21	73.71	82.10	89.13	96.32	95.76	100.19	104.70	86.20	90.82
Humic acid(soil drench)4g/L^{-1}	71.66	72.23	86.03	76.55	85.20	90.46	104.41	100.65	86.82	84.97
Sea weed (Spray)1g/L^{-1}	95.08	117.07	125.43	133.71	142.75	142.93	155.14	159.61	129.60	138.33
Sea weed (Spray)2g/L^{-1}	105.30	129.55	149.25	155.42	172.85	183.33	187.14	188.23	153.63	164.13
Glutamic acid(Spray)1g/L^{-1}	88.20	98.85	107.55	110.93	119.43	120.48	132.84	137.63	112.005	116.97
Glutamic acid(Spray)2g/L^{-1}	90.95	78.75	101.82	108.82	116.22	119.93	127.59	132.73	109.14	110.05
Mean	75.24	82.24	92.56	96.35	103.50	107.40	115.50	118.35		
Lsd at 0.05	First season: a= 14.3 b= 21.5 a*b=43.0 Secondseason: a = 11.9 b = 17.9 a*b=35.8									
Lsd at 0.01	First season: a= 10.6 b=15.9 a*b=31.8 Secondseason: a =8.8 b= 13.3 a*b=26.5									

Effect of sea weed extracts and some biostimulants and their interactions on the main components of tubers fixed oil identified by GC-MS.

	Components	Sea weed4g /L^{-1} (soil drench)and sea weed2g/L^{-1} (spray)	Sea weed4g/L^{-1} (soil drench) and sea weed 1g/L^{-1} (spray)	sea weed 4g/L^{-1} (soil drench) and Glutamic acid 1g/L^{-1} (spray)	sea weed 4g/L^{-1} (soil drench) and Humic acid 4g/L^{-1} (soil drench)	Control
3.288	2,5-Dimethoxycinnamic acid	1.47	1.03	0.74	1.08	0.8
3.92	6,2',4'-Trimethoxyflavanone	1.14	0.53	0.58	0.9	1.01
4.281	2',5'-Dimethoxyflavone	0.32	0.55	0.47	0.57	0.51
4.56	4-Hydroxychalcone	0.42	0.5	0.48	0.44	0.62
4.666	3-O-Methylgallic acid	0.5	0.5	0.47	0.98	0.96
5.105	6,3',4'-Trimethoxyflavanone	0.19	0.47	0.44		
5.388	5-Hydroxyisovanillic acid	0.33	1.01	0.45	0.21	
5.708	Hexa-hydro-farnesol	0.44	0.54	0.5	0.2	0.4
6.298	Benzoic acid, 4-hydroxy	0.25	0.43	0.49	0.23	0.43
7.036	Phloroglucinol	0.43	0.44	0.49		
8.103	Flavone,3',4',6,7-tetramethoxy	0.4	1.07	0.88	0.57	0.47
9.095	Tetra-O-methylfisetin	0.72	0.74	0.72	0.34	0.49
9.796	Shikimic acid	0.97	1.08	1.34	1.1	0.46
11.498	Juniper camphor	1.38	0.86	0.7	0.65	0.57
12.802	Gentisic acid	1.72	0.45	0.6	1.54	0.96
13.389	β-Ionone	5.1	0.43	0.97	2.07	1
15.128	Phytol	4.56	0.44	0.96	2.41	0.93
15.472	Quercetin 3,5,7,3',4'-pentamethyl ether	3.67	0.41	0.72	3.78	0.76
15.648	Scutellarein tetramethyl ether	7.68	0.63	0.74	5.89	1.01
16.345	Naringenin	8.77	0.78	1.14	7.14	1.13
16.629	3',7-Dimethoxyflavonol	10.6	19.03	17.4	8.88	16.17
16.854	Isoflavone, 3',5,7-trihydroxy-4'-methoxy-	1.75	1.51	1.67	1.39	2.06
17.292	Afromosin 7-O-glucoside	6.87	0.51	0.54	0.67	0.42
17.719	Gossypetin 3-methylether	1.84	4.31	3.89	8.03	3.56
17.928	4',6-Dimethoxyisoflavone-7-O-β-D-glucopyranoside	2.49	1.4	2	10.56	2.23
18.118	Elaidic acid	14.49	39.27	37.74	16	36.69
18.342	Casticin	9.61	11.68	12.17	3.68	9.15
18.547	3-Hydroxy-6,3',4'-trimethoxyflavone	1.76	1.75	1.42	1.59	0.78
19.135	4'-Methoxy-6-methylflavonol	1.04	0.94	1.07	1.83	1.33
19.536	Linoleic acid	1.07	0.41	0.53	0.74	0.47
20.012	Kaempferol 7-O-glucoside	0.67	0.63	0.43	1.77	1.3
20.508	Luteolin 5,7,3',4'-tetramethylether	1.01	1.37	1.11	2.28	1.06
20.902	6,7,3',4'-Tetramethoxyisoflavone	0.86	0.81	0.8	1.2	0.79
21.218	7,3',4',5'-Tetramethoxyflavanone			1.06	1.13	1.4

21.513	Ledol	1.17	0.71	1.24	1.56	1.07
21.972	(S)-(-)-Citronellic acid	0.74	1.16	0.42	1.32	0.71
23.027	3,8"-Biapigenin	0.59	0.71	0.76	1.41	1.64
23.444	3',4',5',5,6,7-Hexamethoxyflavone	0.71	0.49	1.32	1.56	1.86
22.39	Isovitexin	1.41				1.41
23.055	3,4-Dihydrocoumarin					1.53
22.395	Squalene				1.62	
3.452	2'-Hydroxy-2,4,5'-trimethoxychalcone	0.39	0.44	0.54	0.46	0.54
5.913	Luteolin 6-C-glucoside	1.18				
15.648	Scutellarein tetramethyl ether		0.63			
6.827	5,7-Dihydroxy 3,3',4',5',6,8-hexamethoxyflavone	0.74				
16.472	Phytanic acid					1.34

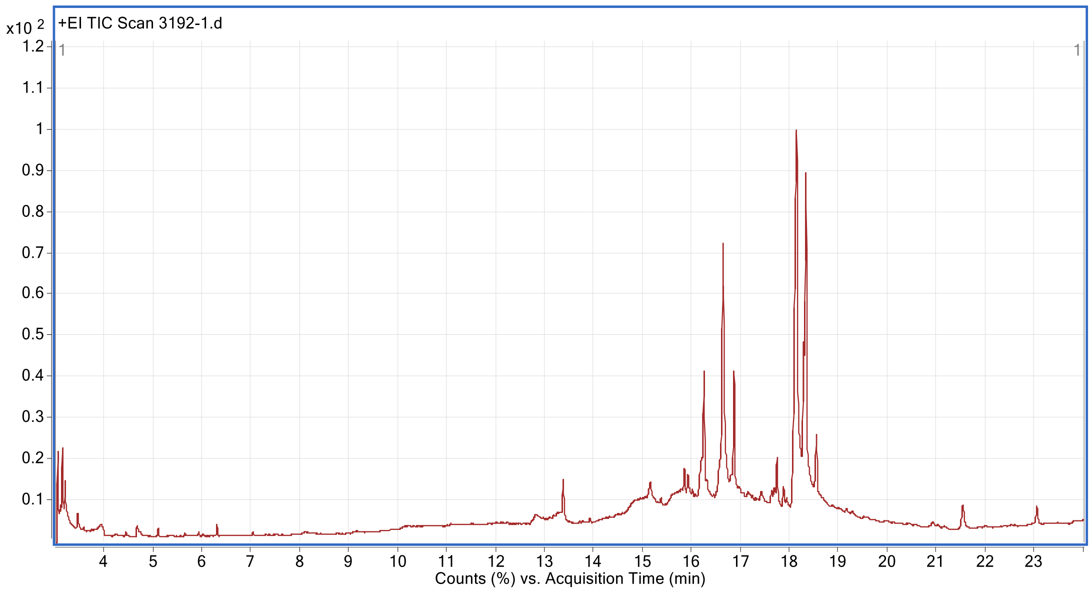

Fig. 1. Chart of GC-mass chromatogram of cyperus esculantus L. seed-oil from the plants treated with soil drenched sea weed4g/L^{-1} and sprayed sea weed(2g) during the second season (2023/2024).

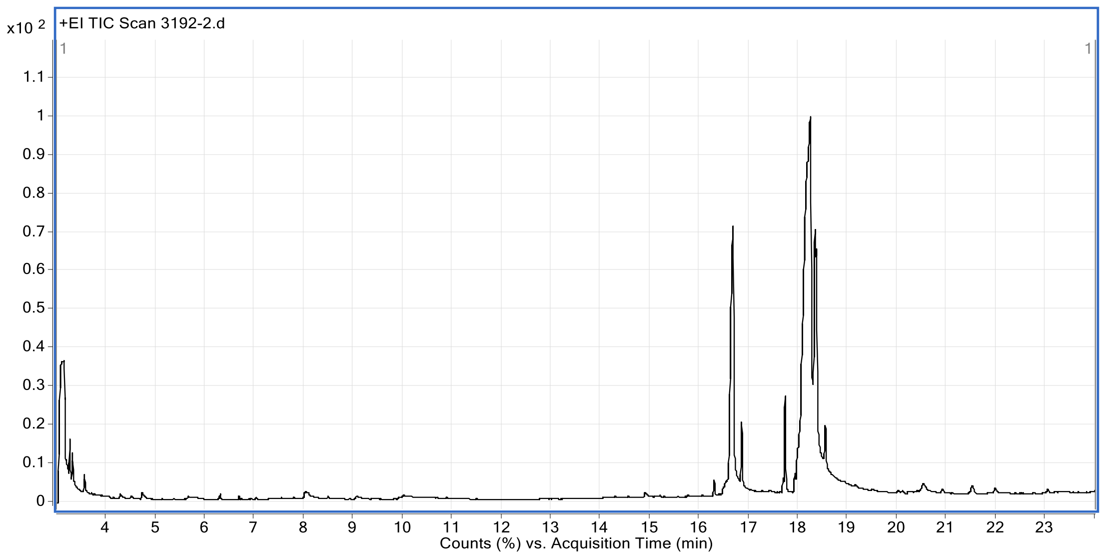

Fig. 2. Chart of GC-mass chromatogram of cyperus esculantus L. seed oil from the plants treated with sea weed (1g/L^{-1}) and sea weed(4g/L^{-1}) during the second season (2023/2024).

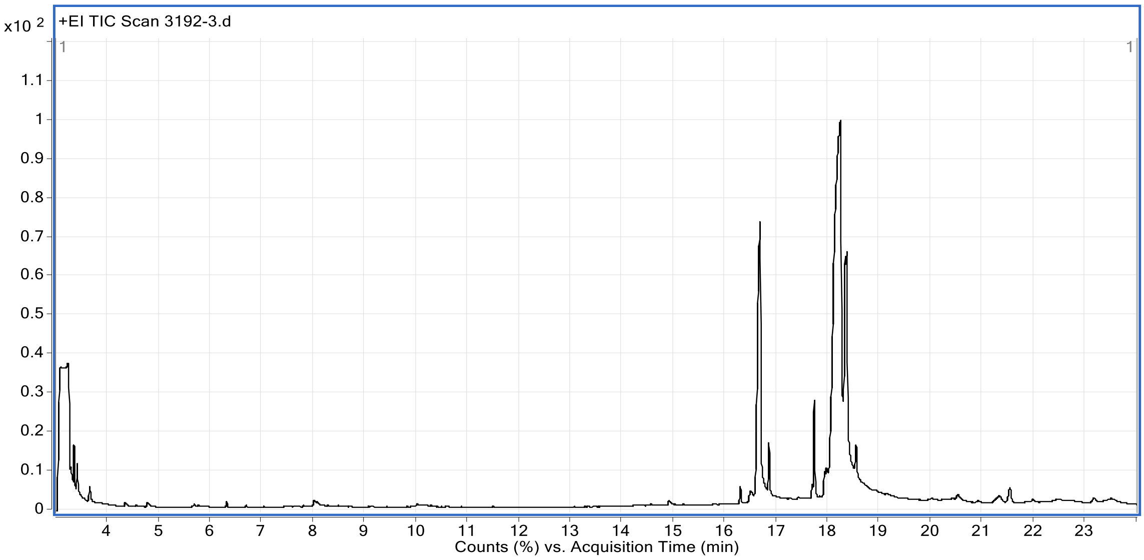

Fig. 3. Chart of GC-mass chromatogram of cyperus esculantus L. seed oil from the plants treated with glutamic acid (1 g/L^{-1}) and sea weed(4g/L^{-1}) during the second season (2023/2024).

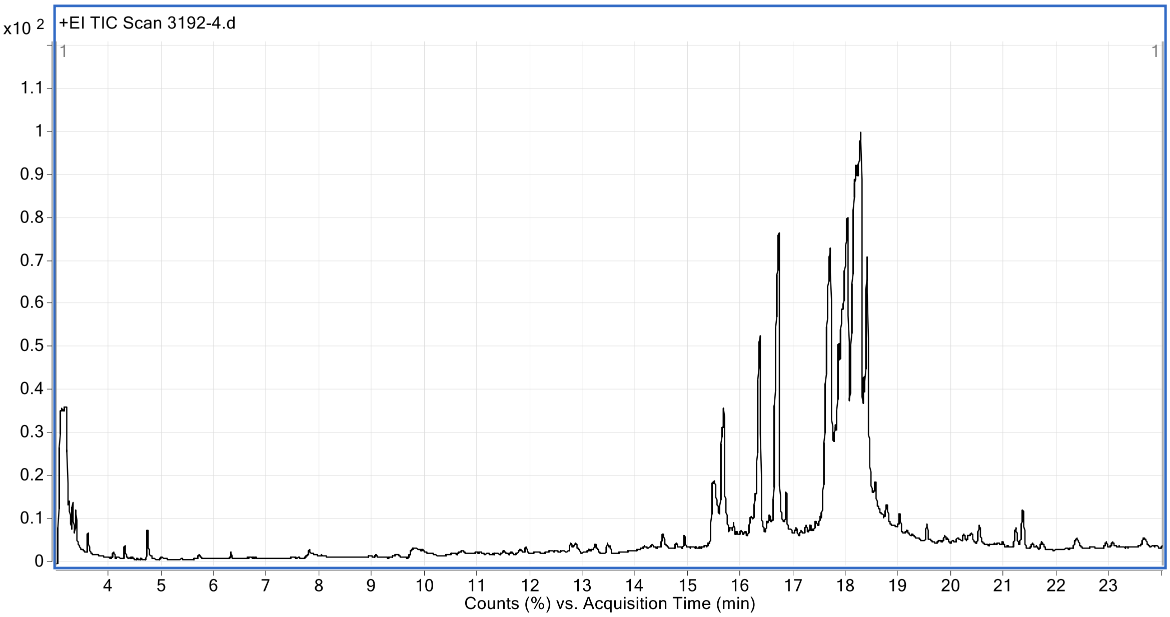

Fig. 4. Chart of GC-mass chromatogram of cyperus esculantus L. seed oil from the plants with humic acid(4g/L^{-1}) and sea weed(4g/L^{-1}) during the second season (2023/2024).

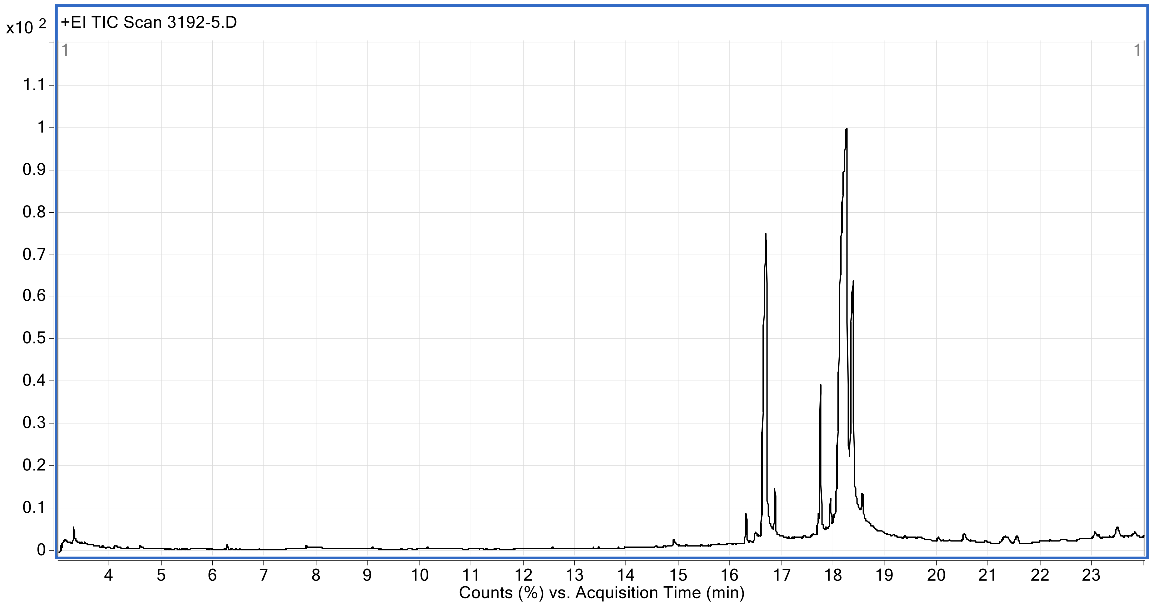

Fig. 5. Chart of GC-mass chromatogram of cyperus esculantus L. seed oil from the plants treated with only sea weed(control) during the second season (2023/2024).

Fixed oil components:

GC-MS identification of the main components of cyperus esculentus tubers fixed oil fig 1,2,3,4,5 demonstrates that sea weed extracts (Ascophyllum nodosum) with both methods of application (4g/L^{-1} as soil drench combined with 2g/L^{-1} sprayed) casued increament in the detected componants of fixed oil to 40 compounds. The increase in oil content included luteolin 6-c-glucoside also known as isoorientin, is a flavonoid compounds with molecular formula C2,H20O11 and 5,7-Dihydroxy 3,3,4,5,6,8-hexamethoxy flavone is a flavonoid component,those found only as a results of this treatment , also including unsaturated fatty acids such as Elaidic acid which recorded the least value (14.49%) followed ascendingly with sea weed 4g/L^{-1} combined with 4g/L^{-1} humic acid both applied as soil drench.while the highest value (39.27) gained by soil drenched sea weed 4g/L^{-1} compined with sprayed sea weed 1g/L^{-1} followed descendingly by soil drenched sea weed 4g/L^{-1} compined with sprayed glutamic acid 1g/L^{-1} gave (37.74) and control (untreated plant (36.69)).Additionally soil drenched sea weed 4g/L^{-1} compined with sprayed sea weed 2g/L^{-1} produced the highest value of linoleic unsaturated fatty acid (1.07) as compared with other two compination treatments and control (untreated plants) .

However, the combined treatment of soil drenched sea weed 4g/L^{-1} and sprayed sea weed 1g/L^{-1} produced the highest value (19.03) of 3’,7-Dimethoxy flavonol followed by sea weed 4g/L^{-1} combined with glutamic acid 1g/L^{-1} as recorded (17.40). also, the mentioned treatment in the pervious line was produced the highest value of casticin (12.17) known as vitexicarpin,is a methoxylated flavonol followed by soil drenched sea weed 4g/L^{-1} combined with sprayed sea weed 1g/L^{-1} as recorded (11.68) furthermore both Naringenin and Scutellarein tetramethyl ether (are flavonoid compounds) were detected in the highest values with the compined.treatment of sea weed 4g/L^{-1} as soil drench and sprayed sea weed 1g/L^{-1} they recorded (8.77 and 7.68) respectively followed by sea weed 4g/L^{-1} combined with humic acid 4g/L^{-1} both applied as soil drench they recorded (7.14 and 5.89) as compared to other treatments and control (untreated plant), the same compined treatments menthioned in the previous line increased phytol (diterpene Alcohol) and quercetin 3,5,7,3’,4’-pentamethyle ether (flavonoid compound)as compared with other combined treatments and control on the other hand the treatments of sea weed 4g/L^{-1} combined with humic acid 4g/L^{-1} both applyied as soil drench caused an increases in the values of 4’,6-Dimethoxyisoflavone-7-O-β-D-glucopyranoside (10.56) is a flavonoid glucoside also,increased the value of Gossypetin3-methylether (8.03) also known as methyl quercetin is a flavonoid compound with molecular formula C16H12O8 as compared with the other two compined treatments and control .also the same abovementioned treatment is obviously detected a unique component called squalene is a polyunsaturated hydro carbon composed of six isoperene units .the control untreated plants caused the appearance of phytanic acid is a saturated branched –chain fatty acid with the chemical formula C20H40O2.unlike most fatty acids,phytanic acid cannot be metabolized by β-oxidatoin due to its branched structure;instead,it undergoes α-oxidation in peroxisomes.this process is crucial for its degradation ,and impairments can lead to the accumulation of phytanic acid, associated with disorders such as Refsum disease. From the GC-Mass figures and table 16 tiger nut tuber revealed that tiger nut oil contain low polyunsaturated fatty acids linolenic acid,high Elaidic acid (is unsaturated fatty acid specifically ,it is transform of oleic acid),citronellic acid (unsaturated fatty acid) Gentisic acid (is unsaturated aromatic acid)Dimethoxy cinnamic acid,Hydroxychalcone unsaturated compound,o-Methylgallic acid (unsaturated compound) Benzoic acid,Hydroxy isovanillic acid,Hexa-hydro farnesol (saturated compound) phloroglucinol (saturated compound shikmic acid (unsaturated acid)Junipar camphor (terpene compound) phytol (diterpene alcohol),ledole(sesquiterpene),Biapigenin(biflavonoid compound),isovitexin(flavonoids compound especially the 6-c-glucoside of apigenin) 3,4-Dihydrocoumarin (lactone compound),luteolin 6-c-glucoside),kaempferol 7-O gluoside (flavonol glycoside),4',6 Dimethoxyisoflavone -7-Oβ-D glucopyranoside (flavonoid glycoside) Also contain17 flavonoid compounds. the chemical constituents of tiger nut oil is an indication that the oil could have pharmacological benefits in other words, tiger nut oil (chufa) could have various medicinal applications. It is regarded as high quality edible and stable oil obtained from the tuber is said to be superior oil that compares favourably with olive oil the oil is golden brown in colour and has a rich,nutty taste the oil remains in a uniform liquid form at refrigeration temperature. this makes the oil suitable for salad making it also has higher oxidative stability than other oils due to its extraction without adding any external heat (cold pressed oil) and it is highly recommended for cooking over other oils because it is more resistant to chemical decomposition at high temperatures.in the textile industry, the oil is used to waterproof textile fiber the oil compares well with corn,soybean,olive and cotton seed oil and can thus serve as s substitute for these oils. The oil is a potential source of biodiesel and much research has been conducted (He *etal*.1996).the brown and black species of tiger nut is an excellent medicine for breast lumps and cancer.the tubers have a relatively high total antioxidant capacity. Because they contain considerable amounts of water-soluble flavonoid glycosides. consumption of antioxidants could protect the immune system of malnourished populations. The intake of antioxidant.containing foods may dalay the progression of HIV infection to AIDS. Tiger nut is one of the earliest domesticated crops and in fact, was found in vases and was used to embalm bodies of the Egyptian pharaohs. In Egypt tiger nut is available in fresh ,semi-dried and dried form in the markets where it is sold locally and consumed even uncooked. A lot of people eat the tiger nut without knowing the nutritional benefits and products that can be obtained from it like tiger nut oil,milk and flour.

Conclusion

From this study results we could recommend to apply sea weed using sea weed (Ascophyllum nodosum) extract by two application method as soil drench at $4g/L^{-1}$ and or $3g/L^{-1}$ respectively combined with foliar sprayed method of sea weed $2g/L^{-1}$ to improve tiger nut tubers and their fixed oil yield and constituents.

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منشطات النمو الامنه لتحسين النمو الخضري ومحصول الدرنات والزيت الثابت لنبات حب العزيز

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اجريت هذه التجربه خلال موسمين صيف متتاليين2022–2023و2023–2024 بمزرعه الزينه بقسم البساتين بكليه الزراعه جامعه بنها لدراسه تاثير الاضافه ببعض المنشطات الحيويه على نبات حب العزيز(. cyperus esculentus L) وهو من عائله السعديات ,و ينتج جذورا ودرنات من القاعده. اجريت دراسه تاثير مستخلصات الطحالب البحريه (Ascopyllum nodosum) بتركيزات (0,2,3,4جم\ لتر) باضافتها للتربه او رشها على ا لنباتات بتركيزات(0, 1,2جم\لتر) او المعامله بالشيتوزان اضافه ارضيه (2,0سم\لتر)او رش على النباتات بتركيز(2,0سم\لتر) واضافه حمض الهيوميك للتربه (0,4 جم \لتر)او رش على النباتات بتركيزا (2–0 جم \لتر) .ايضا حمض الجلوتاميك اسد رشا على النباتات بتركيز(0,1,2جم \لتر).اجريت جميع المعاملات وتم قياس تاثيرها على النمو الخضرى ومحصول الدرنات والزيت الثابت ومكوناته .,واظهرت النتائج ان كلا من طريقتى الاضافه على التوالى,اثرتا بشكل ايجابى على نمو وانتاجيه كلا من الدرنات والزيت الثابت لنبات حب العزيز .ويهدف البحث الى استخدام المنشطات الحيويه الصديقه للبيئه والمنخفضه التكلفه ويفضل استخدام المنشطات الطبيعيه من جميع المزارعين لما لها من دورا حيويا فى زياده انتاجيه التربه والاستدامه وانتاج الاغذيه العضويه والمركبات الطبيه النظيفه,واظهرت النتائج ان اضافه الطحالب البحريه اضافه ارضيه باعلى معدل 4جم\لتر متبوعا ب3جم\لتر ادى الى زياده معنويه كبيره فى الوزن الطازج والجاف لكل نبات و لكل وحده تجريبيه و زياده محصول الدرنات ومحصول الزيت الثابت لكل نبات ولكل فدان فى حين ان الرش الورقى بالطحالب البحريه بكلا المعدلين 2,1جم\لتر اظهر اكبر زياده معنويه اعلى من الاضافه الارضيه فى معظم الصفات المذكوره سابقا, وقد ادت المعاملات المشتركه فى التربه بالطحالب البحريه 4جم\لتر ثم 3جم\لتر مع رش الطحالب البحريه 2جم\لتر الى اعلى قيم الزياده و التحسين الى اعلى القيم لمعظم صفات النمو الخضرى ومحصول الدرنات ومحصول الزيت الثابت للنبات و للفدان بالاضافه الى اعلى قيم المكونات الرئيسيه للاحماض الدهنيه غير المشبعه والفلافونات والفلافونيدات والجلوكوسيد فلافونويد والتربينات المشبعه و غيرالمشبعه والاحماض العطريه .اوصت نتائج الدراسه باستخدام الطحالب البحريه((Ascopyllum nodosum)) بطريقتى الاضافه للتربه 4جم\لتر و3جم\لتر على التوالى , مع الرش الورقى ب 2جم \لتر من الطحالب لزياده انتاجيه الفدان من درنات حب العزيز ومحتواها من الزيت الثابت ومكوناته الفعاله .